Reverse Channel

As indicated, the proposed reverse channel utilizes a 56 KHz bandwidth which is used for pager responses. If the reverse message rate is approximately 600 bps, the 56 KHz band achieves about 20 dB processing gain utilizing spread spectrum CDMA modulation. In fact, the Freeman system anticipates using a direct sequence, pseudo noise, spread spectrum, code division multiple access modulation process for all transmissions on the reverse channel. Some experimentation will be required to select the R-F channel carrier type (FSK, BPSK, etc.) for maximum battery power conservation. The CDMA response system will be operated using asynchronous techniques.

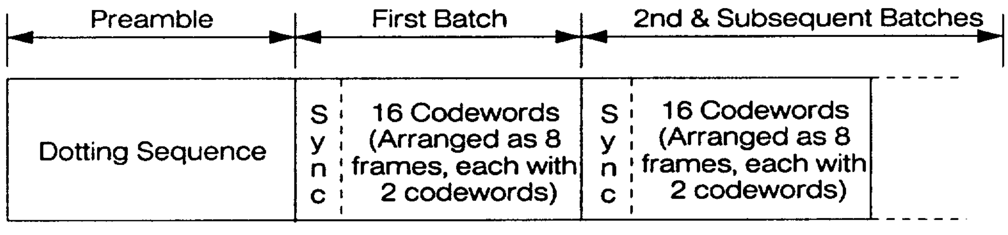
Due to the relatively low data rate of 600 bps, the proposed Freeman system will be robust in the presence of multiple interferors. However, the data rate will not permit large volumes of data to be returned to the system over the reverse channel.

CODE FORMAT AND PROTOCOL

Figure 2 illustrates the code structure of the proposed Freeman system. It is based on the POCSAG format which has been used world-wide for many years. The calling channel, Channel 1, is a synchronous channel in which one "Sync" word is sent for every 16 addresses. Pagers are assigned to one of eight frames based on some algorithm which is typically the last character in their access code.

Modeled after the widely used POCSAG format

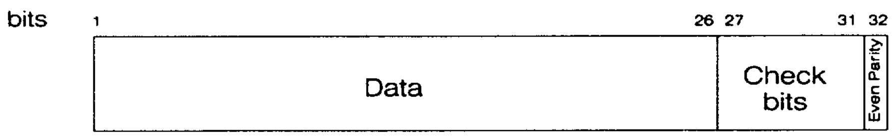
Channel Structure



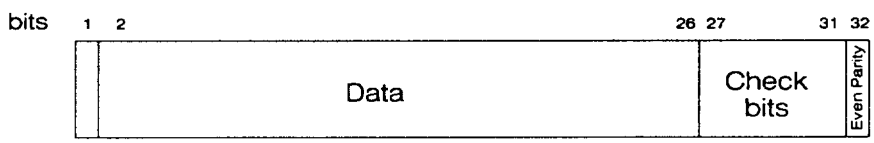
The channel is synchronous and the preamble will be necessary only on rare occasions.
Sync is a special word synchronization codeword.

Codeword Structure

One Codeword consists of 32-bits. Most configurations of codewords use an error correcting BCH (31,26,1) structure plus one fill-bit which is used as a parity bit. Some message codewords do not conform to this convention.



Codeword Types



Notes:

Bit 1 is always either 0 = address codeword or 1 = other

Synchronization codeword assigned a hex value of 7CD215D8. Used for word sync.

Address fill codeword assigned hex value of 7A89C197. Used as fill on synchronous address channel when no paging messages are pending.

Figure 2 - Code Format

Codeword Types - continued

Address Codeword

bits	1	2-3	4 – 21	22 – 26	27 – 31	32
	0	Type	Address	Message Channel Number	Check bits	Even Parity

bits 2-3 Reserved, set to 00 for address message type

22-26 Message channel number 2 to 32 if message pending.

If = 0, no message pending.

If = 1, no message pending, transpond on response channel.

if > 1, move to designated sub-channel for message

Note: sub-channel number = message number

Message Codeword - Type 1 - Alpha and numeric

bits	1	2-3	4	5 – 26	27 – 31	32
	1	00	AWC	Message bits	Check bits	Even Parity

bits 2-3 are message type designators - 00 for Message Type 1

bit 4 is 1 if more message words are coming,

0 if this is the last message word

Message Codeword - Type 2 - Binary and Voice

bits	1	2-3	4	5 – 26	27 – 31	32
	1	01	AWC	Message bits	Check bits	Even Parity

bits 2-3 are message type designators - 01 for Message Type 2

bit 4 is 1 if more message words are coming,

0 if this is the last message word

Message Codeword Type 3 (10) and Type 4 (11) are reserved

Figure 2 - Code Format

For example, a pager which has an address ending in zero or one might be assigned to frame one; one with a last digit of two may be assigned to frame two and so on. In this manner, pagers are placed in one of eight frames which represents three binary address bits. The frame arrangement is required to employ battery saving techniques by which a pager literally shuts down during frames other than its own. This is shown on Figure 2, labelled as Channel Structure.

Each codeword has a structurally similar appearance irrespective of its purpose. Typically, a codeword is 32-bits long in which the first 26 bits are used for data and the remaining bits are used for error detection and correction. All data in the system is encapsulated in an error-correcting block code referred to as a BCH(31, 26,1) code which has the ability to correct one bit. This is illustrated in Figure 2 under Codeword Structure. Note that in future definitions, some codewords can be defined which do not conform to the convention indicated in the codeword structure. This is because different types of transmission may be required and will be indicated by the codeword types which may be dynamically negotiated. For example, a Type 3 message code may result in the pager switching to a message channel and then setting up the protocol and format for the remainder of the message. The new protocol may or may not have the same structure as that indicated in the codeword structure of Figure 2. This will permit the future use of variable length binary data, with or without error correction, and any other of a variety of messages that can be formulated digitally. Under these circumstances the system would service the various message types based upon the type of pager being paged. Recall that pager is a generic term and can take on many forms.

Normally, in the proposed Freeman system, codeword types will conform to the convention described in Figure 2. Once the address has been decoded and the pager has moved to the working channel, its messages will have the form shown for Type 1 and Type 2 message codewords. The distinction between the two codeword types occurs in bits two and three of each word. As indicated, types three and four are reserved for future purposes. Message codewords will continue to be sent sequentially until the message is completed. Bit four in the message codewords has been assigned as an "another word coming" bit which indicates that the current word is or is not the last word of the message. Each message codeword nets 22 bits out of 32 for the message which is reasonably efficient considering the error correction capability. If greater efficiency is necessary, message codeword types three and four could be defined to utilize up to 100% efficiency. However, this is not a recommended practice. Typically, when the parity fails or the check bits fail, the pager will not return a message receipt response which will then force the system to resend the message as many times as required to get it correct. But, even this does not have to be a hard, fast rule. Different levels of reliability could be utilized by the system operator to provide different levels of performance to different subscribers on the same system for different prices. These matters will be incorporated into the operational considerations of the system and do not require any changes to the technical characteristics of the paging system.

The calling channel, Channel 1, is synchronous and all pagers continuously decode this channel unless they are operating on a subchannel. Occasionally, during idle periods, the system will not have an active address to put in every codeword. In that case, an address codeword, which may not be assigned to a pager, is used as a fill word. In this case, we have selected the same codeword that is used in the POCSAG format. Between each group of 16 codewords, the system will send a word synchronization so that pagers which are just joining the bit stream can synchronize to the first frame. The pager thus knows when to sleep and when to wake up to look at its frame for an address match.

EQUALIZATION OF SIMULTANEOUS SYSTEM

Existing simultaneous transmission systems operating at 900 MHz do not require complex, high accuracy equalization. However, when bandwidths become large (with faster bit rates or higher modulating frequencies) then the equalization of the systems becomes critical. In any simultaneous transmission system, a number of requirements must be fulfilled for the system to work properly to ensure signals from two or more transmitters add coherently without total destruction and chaos. One of the requirements is that all transmitters start transmitting at precisely the same time. This means that each transmitter in a simultaneous system which is within range of a receiving pager must be time-delayed so that signals arriving at the pager are in step with each other. Two signals arriving at a pager delayed in time by one-half cycle of the highest modulating frequency will cause that frequency to cancel. Once this happens, the pager can no longer accurately decode a message. The fundamental reason for simultaneous systems is to provide elevated signal levels in areas where signals are lowered by penetration of buildings or behind obstacles or for various other reasons. Illumination of a difficult area from a nearby transmitter often allows paging where none would otherwise exist.

In high-speed digital or analog systems, higher and higher modulating frequencies require equalization of transmitting times to smaller and smaller values. For example, a system which uses 19,200 bps will be cancelled if two signals arrive at the receiver with equal strength and displaced in time by about 26 microseconds. Can this happen in a real system? The answer is yes. Since r-f signals move about one mile in 5.3 microseconds, transmitters within five miles of the receive location can interfere. A pager which is located one mile from one transmitter and six miles from another transmitter will be interfered with if signals from the closer transmitter are very slightly attenuated relative to the signals coming from the more distant transmitter. This is true even with equalized transmitters. As the distance between transmitters increases, the probability of the more distant transmitter having the same signal level as the closer transmitter diminishes. Because modern receivers are designed to reject co-channel interference, once the signals differ by about 6 dB, the receivers will have a tendency to reject the signal from the weaker transmitter in deference to that from the stronger transmitter. This is comparable to the capture effect which is prevalent in wideband FM transmission. Systems which utilize conventional analog paging typically have a high modulating frequency of about 3000 Hz and will be equalized for transmitter differential distances of some 15 miles. This will generally provide a ratio of signal levels which is adequate to provide excellent reliability. In designing simultaneous systems, the firm of Arthur K. Peters specifies that the equalization of the system shall be within 90° or 1/4 period of the highest modulating frequency for reliable results.

The proposed Freeman system has an upper modulating frequency of about 127.5 Kbps, which would result in a maximum transmitter differential distance of less than one mile before cancellation would occur. This is clearly unacceptable since no transmission system will place transmitters within two miles of each other so as not to exceed the maximum differential distance. Freeman's paging system utilizes special considerations and special signal processing to circumvent the untenable equalization requirements and still provide reliable paging using high frequency signals. Appendix A is a diagram which shows an arbitrary dashed circle which represents the desired service area of a simultaneous system. Within that circle and centrally located is a circle representing a centrally located base station of arbitrary size but chosen to keep a single tier of transmitters serving the area. In any such configuration with practical area coverages, the area between stations where signals from each of the transmitters are within 6 dB of each other represents about 30% of the area of the desired service area (dashed). This is essentially independent of the radius of the circles. In this zone, shown shaded in Appendix A, the signals from any two or three transmitters are within ±3 dB of each other. This is the zone where the receiver co-channel rejection feature will not function optimally. Interestingly, in the areas between any two or three circles, a properly equalized system will provide coherent signals which will not be mutually destructive. The only places where mutual destruction may be expected, would be areas that are outside the ring of transmitters.

We then have a situation where, in a properly equalized system, signal levels and equalizations would be expected to achieve reliable coverage. In such situations transmitters are located in places where they are needed such as central downtown districts, hospitals with heavily constructed buildings and other such difficult-to-serve areas. Once these areas have been served, the randomness of signal variations will be the only factors producing unreliable results. In general, a simultaneous system which employs enough transmitters to keep the average signal level high will have very few full cancellation of signals due to the summation of out-of-phase signals. It is much more likely that a pager will be in a location where the signal penetration into a building is low or might be shielded from some nearby object. In general, when the average signal levels are high, the simultaneous system excels in reliabiilty. When average signal levels drop to levels where cancellations due to multipath or reflections cause levels to drop below the receiver threshold, then the simultaneous systems tend to behave badly. Typical transmitter spacings of five miles would keep signal levels very high and produce excellent results. As transmitter separation distances increase, signal levels between transmitters tend to decrease until the reliability of the system diminishes below acceptable levels.

In the Freeman system, the base stations will always be equalized so that the first two subchannels are fully equalized throughout the system. Subchannels above 2 will not be equalized and will have a slightly elevated probability of error associated with them. There are two factors which come into play in this scheme.

One concerns the areas where the signals might be of approximately equal magnitude as illustrated in Appendix A. This represents approximately 30% of the total service area in a fully implemented simultaneous system. The second factor involves the ability to equalize only the first two subchannels. Appendix B has been prepared to illustrate the r-f energy appearing in the band. As shown in Appendix B, most of the energy in the FM signal associated with the first two subchannels will be contained in the spectrum between the carrier and approximately 7.4 KHz above and below the carrier. In narrowband FM, the signals approximate those of AM spectra with the exception that one side-band is 90° out of phase. It is demonstrated in Appendix B that each of the subchannels is a narrow band modulator even at the lowest frequencies. Therefore, the spectra will cluster around the carrier. Even though there may be r-f energy in higher frequencies, if the entire signal is equalized to 7.5 KHz, then at least the first two subchannels will receive coherent sums and be fully equalized throughout the system.

Outside of the area where signal levels are within 6 dB of each other, the probability for cancellation of signals at any modulating frequency or for any spectra within the FM signal diminishes rapidly. This is commonly observed in existing simultaneous systems, albeit with lower frequency equalization. As the average signal levels increase, the depth of cancellation must be greater which means that the signals have to be more nearly identical to provide complete cancellation. The probability falls dramatically as the requirement for exactness increases. This is precisely why higher signal levels do better in a simultaneous system.

In spite of all the rhetoric concerning the low probability of cancellation, there will be errors occuring in the system for many reasons including unanticipated signal cancellations. With the calling channel and the first subchannel fully equalized throughout the system the errors on those channels will be lower. In fact, errors on those channels will be on the same order as conventional simultaneous systems today which provide very good reliability. The upper subchannels, 3 through 32, will incur, we believe, only slightly elevated errors. However, when an error occurs, the Freeman system will attempt to resend the message. It will do this by first determining that a pager is in the system and available by requesting a pager to transpond on the response channel. Once the pager transponds, the system will resend its message on Channel 2 which is a known high-reliability channel. If the pager still does not receive its message the system will initiate a maintenance report concerning that pager and its approximate location, because it knows which receiver received the transponded pager code. Multiple fault reports in a specific area could point to a need for an additional base station in that area. However, it must be kept in mind that in most cases the base stations will have already been placed at optimum locations for the most reliable service. Builders of simultaneous transmission systems already search for difficult areas of coverage and try to locate base stations nearby for greatest reliability. This further decreases the probability of error because most of the pager traffic will be directed in areas covered by strong, single base station facilities. Typically the areas between base stations are populated by fewer pagers than areas immediately adjacent to serving base stations.

The channel capacity for subchannel 2 is totally independent and left available for error recovery and other functions. The capacity figures given above were calculated for channels 3 through 32. Capacity reductions due to resending signals on Channel 2 would only occur if the number of pages due to retries or errors diminished the capacity of the calling channel, Channel 1. We can identify only one time when this would occur and that would be when the system is comprised of all tone-only and/or numeric pagers and the call rate was over a million in the busy hour, which already implies more than the industry average number of calls per paging subscriber in the busy hour. This is a relatively improbable event since the addressing capability of the system is some 20% below the point at which capacity would be affected by repeats on Channel 2. Another factor would be if Channel 2 reached saturation due to a high rate of error somewhere in the system. It is expected that this condition would be temporary and could be fixed by the proper placement of additional base stations.

If Channel 2 does become totally occupied by retransmitting messages received with errors, any of the remaining subchannels could be used for "retries" as frequently as required. There is a good deal of backup capability in the proposed system. It is unlikely that the condition will ever develop whereby a paging message will not get through due to subchannel cancellations due to errors. The nature of the cancellation process is that if phase delays cancel on one subchannel at some specific frequency, they cannot simultaneously cancel on another subchannel unless it is harmonically related by an odd multiple frequency of the first subchannel. i.e., if you get cancellation in Channel 3, Channel 4 will be available. Therefore, the only reason to send "retries" on Channel 2 is to take advantage of the channel which has been fully equalized throughout the system.

CONCLUSIONS

The following is a list of new, unique or innovative system features and concepts, each of which would qualify as pioneering:

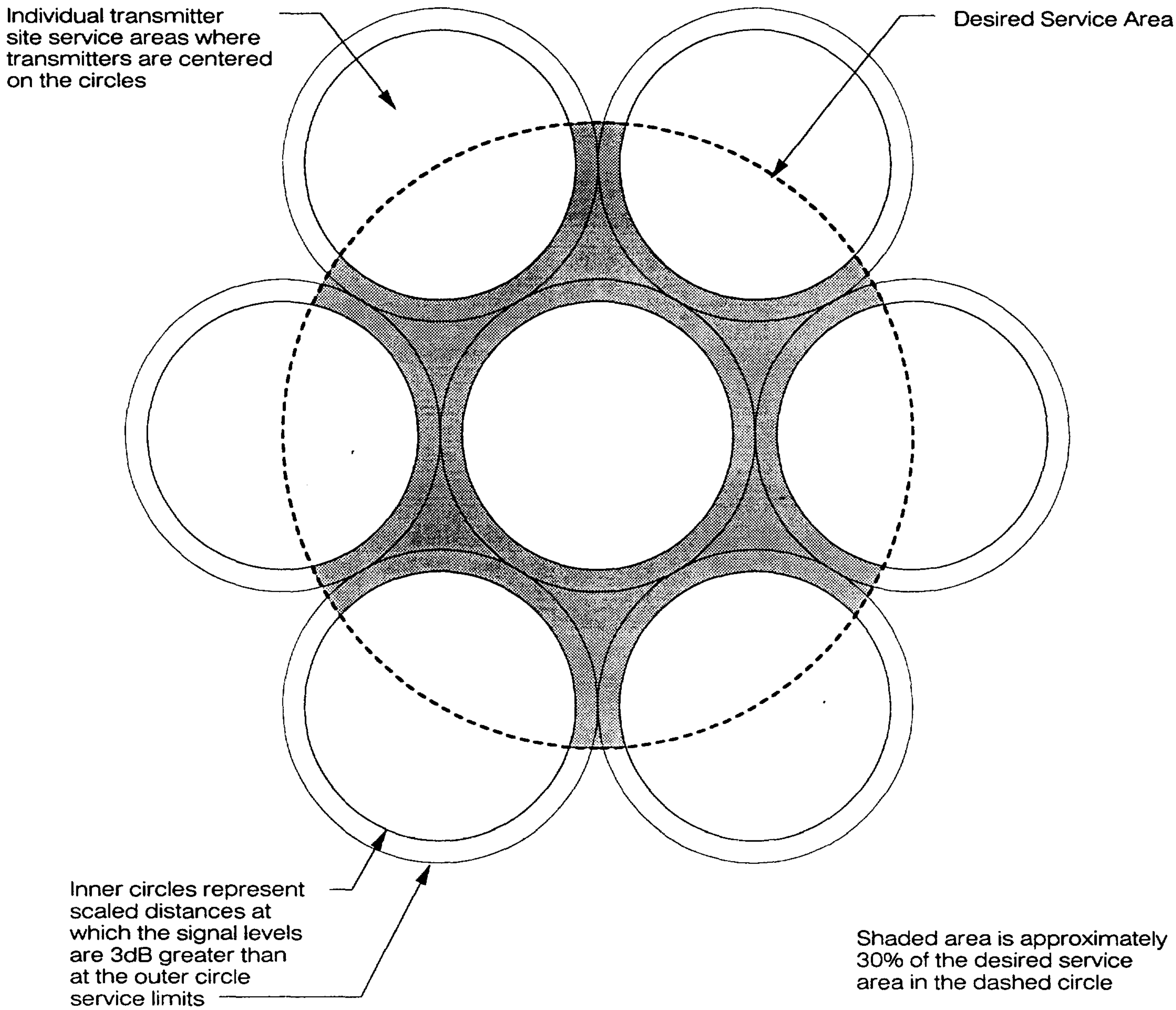
1. Up to 8.3 million subscribers for one system;
2. Up to 40 times greater capacity than current systems;
3. High-quality voice services in addition to all other paging services;
4. Responses which can be delivered as E-mail, voice, character strings, mailbox and TDD information;
5. Variable paging formats which will not obsolete existing pagers;
6. Paging format changes selected by pagers themselves. Accomplished by interactive negotiations between a pager and the system;
7. Simultaneous equalization of wideband system;
8. Special features for the deaf and other disabled persons;
9. One-eighth of the infrastructure costs of equivalent conventional systems;
10. Interference-free response system;
11. Capability of high-speed data delivery using selectable bandwidth techniques;

12. System costs equivalent to conventional systems. Thus, even areas with smaller populations can economically use the system and receive the benefits of greater compatibility.

The summary which Freeman included in its Request for a Pioneer's Preference has been expanded upon in this presentation. A new and innovative system which can be built from available components at costs equivalent to current paging systems has been evaluated and shown to be 4 to 40 times more efficient than equivalent 25 KHz bandwidth conventional channel systems, even when using elevated data rates. The system will function reliably and have a useful life because its coding structure is not fixed and may be expanded in the future without obsoleting existing users. Since the configuration of the system and its costs are comparable with conventional 900 MHz paging system, there is no reason to restrict its use to any particular area or any particular paging format. The definition of the pager to be utilized in the system has been purposely left sufficiently broad to allow generic use of the term "pager". It is anticipated that future paging efforts will utilize high volumes of data over these channels at rates that would not otherwise be available on 25 KHz channels. Moreover, because of the ability to combine two or more data channels the Freeman paging system has the ability to go even beyond its massive capacity and throughput as presently envisioned.

Arthur K. Peters, P.E.

November 6, 1992



The shaded area shows the area in which signal levels from two or more transmitters are within ±3dB of each other. This is the area which has the greatest probability for signal cancellation. However, since all transmitters have been made to be precisely in step (time equalized), the modulation will not differ by the requisite 180° for any modulating frequency contained in the first two subchannels. Therefore, with respect to those subchannels, the Freeman system behaves as a familiar 900 MHz sumultaneous transmitter system. Furthermore, the equipment and techniques used for such equalization are available and familiar.

ATTACHMENT B

DEMAND FOR THE ADVANCED PAGING SERVICES

PROPOSED BY FREEMAN ENGINEERING ASSOCIATES

A Market Research Report

Prepared on Behalf of Freeman Engineering Associates, Inc.

November 9, 1992

TRANSCOMM, Inc.
6521 Arlington Boulevard
Falls Church, Virginia 22042

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Attachments

I. INTRODUCTION, PURPOSE, AND ORGANIZATION OF REPORT

On behalf of Freeman Engineering Associates, Inc. (Freeman), TRANSCOMM was asked to conduct market research on the extent of the demand for the advanced paging services proposed by Freeman in its request for a Pioneer's Preference. Two types of market research were requested. First, two telephone surveys were conducted of businesses in selected industry categories. These were for (1) the combined New Orleans-Baton Rouge, Louisiana (Louisiana) MSAs and (2) the Dallas-Fort Worth, Texas (Texas) MSA. Second, Freeman requested that TRANSCOMM interview several radio paging carriers for their views on the proposed services.

KCA Research Inc. (KCA), a firm specializing in telephone surveys, supported TRANSCOMM in this market research by conducting the two telephone surveys of business establishments. KCA's report on those surveys is included herein as Attachment 1. Separately, TRANSCOMM interviewed several radio paging carriers for their views on the demand for the advanced paging services.

This report describes the methods used to acquire the quantitative survey data and qualitative interview information. It also presents the results and conclusions of this research. The rest of this report is organized into three sections: Section II summarizes the results and conclusions of the research, Section III describes the business establishment surveys, and Section IV describes the paging carrier interviews.

II. SUMMARY OF RESULTS AND CONCLUSIONS

The results of the business establishment surveys indicate that a market exists for the advanced paging services proposed by Freeman Engineering Associates in the MSAs surveyed. The information acquired in the paging carrier interviews confirms this conclusion on a national basis. Specific results and conclusions are summarized below.

Business Establishment Surveys

(1) Businesses in the industrial categories surveyed have a large demand for mobile communications services. Almost one-half of the respondents to the survey were identified as being in the defined target market.[1] Moreover, there is a high correlation between the defined target market in this survey and the use or planned use of mobile services – over 90 percent of the target market respondents currently subscribe to some type of mobile service. Furthermore, on average, several individuals use the service in each of these businesses. This suggests a substantial potential market in those specific industrial categories for the advanced paging services. However, it also suggests that marketing the advanced services will have to emphasize the advanced paging features' utility and price compared to those of other mobile services already well known to and used by the marketplace (*i.e.,* there will be competition and substitution between old and new services).

(2) For business establishments within the defined target market, the advanced paging features have considerable, immediately-recognizable utility. The advanced paging features described in the questionnaire were considered very useful or somewhat useful by a number of target market respondents. Of the advanced paging features described in the questionnaire, the response-back and display paging features were considered useful more often than any other feature. The proportion of target market respondents considering those features useful ranged from 37.0 to 61.2 percent. The utility of voice paging was ranked third (40.3

[1] The target market respondents were those respondents with staff members or other employees who (1) work outside a central location or away from a telephone operator/dispatcher and (2) must be readily accessible for instructions or other matters.

to 42.8 percent) while voice message storage and retrieval was a close fourth (32.9 to 47.1 percent). The utility ranking of wireless transmission of data from a mobile computer was fifth (21.2 to 28.6 percent).

(3) The ranking of these advanced paging features appears to be related to the respondents' familiarity with their use and applications (*i.e.,* the higher ranking for display paging and the need for a message acknowledgement). The three other features are currently unavailable, unfamiliar to the respondents, and their utility and applications may not have been fully considered by those respondents.[2] Typically, users will increasingly recognize the utility of new service features as the availability of the new services generate useful applications. Over time, these new useful applications will become more familiar and, therefore, more in demand throughout the market.

(4) For the industrial categories surveyed, there is a current demand for the advanced paging services, at their expected price level. At the stated price, many target market respondents were interested in the proposed advanced paging services. In the Louisiana markets, 28.6 percent of Group 1 (General Construction) target market respondents were interested, 17.6 percent of Group 2 (Medical and Government), and 19.7 percent of Group 3 (Marine and Petrochemical). In Texas, 3.8 percent of Group 2 target respondents were interested. These figures translate to 2,655 total Group 1, 2, and 3 business establishments (27,910 users) in the Louisiana market that would be interested in the service at the stated

[2] Moreover,only a very small portion of the target market appears to be familiar with paging. For a small subset of the target market respondents (those "interested" in the service at the stated price levels) who now use paging, the proportion of voice paging subscribers ranged from 0.0 percent to 7.0 percent for all groupings in the Louisiana and Texas markets. Typically, low subscription to voice paging is due to lower quality-lower priority transmission, use of pagers which cannot store a voice message, and higher monthly service prices.

price and 438 Group 2 business establishments (1,170 users) in the Texas market. This can be considered an estimate of the initial market demand in the markets for those selected types of business establishments.

(5) The overall interest in the new service at its stated price, as measured by the survey, is likely affected by two considerations. First, most of the respondents were already using or planning to use mobile services. Once using a service, there is a well-known customer aversion to switching from one service to another. Of course, this customer behavior must be addressed in marketing any new service. Second, some of the advanced paging features and their potential applications were unfamiliar to the respondents. For such reasons, the initial demand for a new service or feature is typically very small but, as familiarity with the advantages of the service spread throughout the market, that demand grows considerably (*i.e.,* the standard S-shaped growth curve).

(6) Since only business establishments in selected industrial categories were surveyed, these demand estimates cannot be considered total demand for the proposed advanced paging services within those geographic markets. There are likely a number of business establishments in other industries, as well as residential consumers, who might also be interested in the advanced paging services.

(7) For some establishments, the proposed advanced paging service, being more competitive in either price or features, will replace a current or planned mobile service. In other cases, the proposed service will also expand the number of establishments and individuals using paging services. Survey respondents who were interested in the service at the stated price and who currently use or plan to use mobile services indicated that they may replace those services with the proposed service and/or add the proposed service to those they already use or plan to use. Overall, the survey data indicated that the respondents

"interested" at the stated price and already using mobile services could increase their subscription to mobile services by adding the new service.

(8) The enhanced paging features associated with the proposed paging service are recognized as very useful to business establishments who are already familiar with paging services. Some of the respondents "interested" in the service at the stated price already use a paging service. Most of these respondents agreed that the response-back feature would reduce repeat calls. However, the utility of this feature was viewed differently by various respondents – some felt the feature would increase the number of messages sent (per pager), by generating new instead of repeat messages, while some felt their total number of messages (per pager) would be reduced. This likely reflects differences in customer applications. Further, over one-half of those "interested" respondents that currently subscribe to a non-voice paging service would use the advanced voice service. Perhaps they are familiar enough with current services to recognize that the page-acknowledgement and message storage and retrieval features would be a considerable improvement over current voice paging service.

Paging Carrier Interviews

(9) The comments of the carrier representatives interviewed indicate there is a demand throughout the country for both high-capacity, high-quality voice and the pager response-back feature. Thus, most carriers are interested in a technology that will allow them to serve this unmet demand at a reasonable service price. In many cases, they recognize the longer-term competitive advantage and value-added services revenues they may derive from implementing and actively marketing the advanced services.

III. SURVEYS OF BUSINESS ESTABLISHMENTS

A. Survey Approach

Two separate telephone surveys of businesses were conducted: one in Louisiana and one in Texas. Based on actual paging experience in the New Orleans and Baton Rouge markets and the request of the client, the Louisiana survey concentrated on business establishments within specific industries, identified by their Standard Industrial Classification (SIC) description and code.[3] Three general industry categories were included in the sample frame: (1) General Construction; (2) Medical and Local/State/Federal Government; and (3) Marine and Petrochemical. A further break down of the industries included in the surveys is shown by the following:

Group 1: General Construction

- Construction – General Building Contractors (15)
- Construction – Heavy Construction, Except Building (16)
- Construction – Special Trade Contractors (17)
- Wholesale Trade – Lumber and Construction Materials (503)
- Wholesale Trade – Metals and Minerals, Except Petroleum (505)
- Wholesale Trade – Electrical Goods (506)
- Wholesale Trade – Hardware, Plumbing, & Heating Equipment (507)
- Wholesale Trade – Machinery, Equipment, and Supplies (508)
- Retail Trade – Building Materials & Garden Supplies (52)
- Finance, Insurance, & Real Estate – Insurance Agents, Brokers, & Service (64)
- Finance, Insurance, & Real Estate – Real Estate (65)
- Services – Business Services (73)

Group 2: Medical and Government

- Transportation & Public Utilities – Local Passenger Transportation (4119)
- Wholesale Trade – Professional & Commercial Equipment (504)
- Services – Health Services (80)

[3] It is important to note that in both surveys, only a selected portion of the total universe of business establishments was sampled. The data are representative only of business establishments in those specific industrial categories. Thus, in those surveyed markets, there may be more interest in the advanced paging services than is measured in the current surveys.

- Public Administration – Public Order and Safety (922)
- Public Administration – Administration of Human Resources (94)

Group 3: Marine and Petrochemical

- Mining – Oil and Gas Extraction (13)
- Manufacturing – Industrial Inorganic Chemicals (281)
- Manufacturing – Petroleum and Coal Products (29)
- Manufacturing – Oil and Gas Field Machinery (3533)
- Manufacturing – Ship & Boat Building and Repairing (373)
- Transportation & Public Utilities – Water Transportation of Freight (444)
- Transportation & Public Utilities – Water Transportation of Passengers (448)
- Transportation & Public Utilities – Water Transportation Services (449)
- Transportation & Public Utilities – Pipelines, Except Natural Gas (46)
- Transportation & Public Utilities – Natural Gas Transmission (4922)
- Transportation & Public Utilities – Gas Production and/or Distribution (4925)

In the Louisiana survey, a separate random sample was drawn from each of the three industry categories within the combined New Orleans-Baton Rouge MSAs. The same number of business establishments in each of the three industry categories were selected to be sampled and telephone calls were made to approximately equal numbers of sampled establishments in each group. In the Texas survey, a random sample was drawn and telephoned only for the second category: Medical and Government. The KCA report (Attachment 1) describes the source of the sample, the method used to conduct the phone survey, the response rate, and the statistical validity of the survey results.

The same questionnaire was used in both surveys. The questionnaire itself was developed in conjunction with Freeman Engineering, using the advanced paging service descriptions and prices given to TRANSCOMM by Freeman Engineering. The KCA report contains a copy of the questionnaire.

The questionnaire was designed to provide several types of information. First, an attempt was made to identify those business establishments that would tend to be most interested in the paging services. These entities were considered part of the "target market"